MCIC Report/June 1977 MCIC-77-32

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THE EFFECT OF RAPID HEATING ON THE PROPERTIES OF MATERIALS

A Bibliography With Descriptors

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THE EFFECT OF RAPID HEATING ON THE PROPERTIES OF MATERIALS.

A Bibliography With Descriptors

Compiled by

10 Dorothea M. Johnson

Battelle's Columbus Laboratories

Columbus, Ohio

11 Jun 77

12 86p.

14 MCIC-77-32

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ACKNOWLEDGEMENT

This document was prepared by the Metals and Ceramics Information Center (MCIC), Battelle's Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201. MCIC's objective is to provide a comprehensive current resource of technical information on the development and utilization of advanced metal- or ceramic-base materials.

The Center is operated by Battelle-Columbus under Contract Number DSA900-76-C-2471 for the U.S. Defense Supply Agency; technical aspects of MCIC operations are monitored by the Army Materials and Mechanics Research Center. The support of these sponsor organizations is gratefully acknowledged.

U.S. DEPARTMENT OF COMMERCE

7-27-77

To : Mr. Muse

From: Jim Apistolas

New IAC report (MCIC). Please input. Thanks.

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INTRODUCTION

The effect of severe environments on the properties of structural materials is an area of continuous concern to designers of high-powered engines, high-speed aircraft, reentry vehicles, missiles, rockets, nuclear weapons, lasers, and other military space- and ground-use devices. In such applications, materials may experience conditions beyond their normally recommended temperature ceilings and fracture limits because of unanticipated increases in temperature while under high strain rates. Furthermore, many of the devices have service lives measured in minutes or hours and may be used only once. Such demands upon structural materials present special problems to designers and manufacturers and require a revision in design criteria for structural components.

New data on design-allowable parameters have evolved from numerous studies on the effect of rapid heating on structural materials. A variety of materials have been evaluated in short-time, elevated-temperature tensile tests using one of the following approaches:

- Heat, then load or strain at various rates to failure
- Load, then heat at various rates to a specified temperature--hold until failure occurs
- Load, then heat at various rates until failure occurs.

Experimental studies have also used a variety of heating methods, e.g. (1) electrical resistance and furnace heating, (2) laser heating, and (3) pulsed-electron-beam heating.

The purpose of this document is to provide a ready reference to pertinent literature related to the effects of severe heating environments on the properties of structural materials possibly under consideration for development of military space- and ground-use devices.

SCOPE

Aerospace engineers and designers have shown an interest in the effect of rapid heating on the properties of materials. In response to this interest, a collection of relevant publications has been compiled in this bibliography report. This bibliography, which is annotated by descriptors, contains references to over 350 documents published from 1948 to 1976. The bibliographic citations are arranged in chronological order and in alphabetical order by last names of first authors and by year of publication. A continuous numbering system is used throughout the bibliography, and accession numbers are employed as locators in all of the indexes.

MATERIAL/PROPERTY INDEXES

Combined Material/Property Indexes are provided for the convenience of readers. References relating to the mechanical properties of a material are readily identified and completely separated from the surface effects (damage), microstructural changes (bulk damage), thermal properties, and electrical properties. For example, data for aluminum is retrievable from five separate indexes:

Material (Aluminum)/Surface Effects Index
Material (Aluminum)/Microstructural Changes Index
Material (Aluminum)/Mechanical Properties Index
Material (Aluminum)/Thermal Properties Index
Material (Aluminum)/Electrical Properties Index

Readers interested in surface effects, surface damage, optical properties, or physical properties of a given material should utilize the Surface Effects Index. While those interested in phase transformations, bulk damage, or destructive actions should enter the literature collection through the Microstructural Changes Index.

A tabulated summary of material groups and their associated properties is given in Table 1.

In the published literature, different proprietary designations are occasionally applied to the same alloy. For consistency in the indexing of such alloys in the report, a common designation was selected in accordance with accepted international alloy descriptors. Table 2 illustrates some of the reported and indexed designations that were used.

TABLE 1. MATERIAL AND PROPERTY INDEX SUMMARY

Material	Surface Effects(1)	Microstructural Changes(2)	Mechanical Properties	Thermal Properties	Electrical Properties
Alkali Halides	x	x	x	x	
Aluminides	x	x	x		
Aluminum	x	x	x	x	x
Antimonides		x			
Arsenides	x	x	x	x	
Beryllium	x		x		x
Bismuth	x	x			
Borides			x	x	
Boron		x			
Bromides	x	x	x	x	
Cadmium	x				
Calcite	x				
Carbides	x	x	x	x	
Carbon/Graphite	x	x	x	x	
Ceramic Materials	x		x	x	
Chalcogenides	x	x	x	x	
Chlorides	x	x	x	x	
Chromium	x	x			
Cobalt	x	x	x	x	
Composites	x	x	x	x	
Copper	x	x	x	x	x
Dielectric Materials	x	x		x	
Fluorides	x	x	x	x	
Germanium	x	x			x
Glass	x	x	x	x	
Gold	x		x		
Intermetallic Compounds	x	x	x		
Iodides/Iodates	x	x			
Iron	x	x	x	x	x
Lead	x	x		x	
Lithium Niobate	x				
Magnesium	x		x	x	
Mirrors	x				
Molybdenum	x	x	x	x	
Nickel	x	x	x	x	x
Niobium	x	x	x	x	
Nitrides			x	x	
Optical Materials	x		x		
Oxides	x	x	x	x	

TABLE 1. (Continued)

Material	Surface Effects(1)	Microstructural Changes(2)	Mechanical Properties	Thermal Properties	Electrical Properties
Paint	x				
Phosphates	x	x			
Phosphorus		x			
Polymers	x	x	x	x	
Proustite	x				
Quartz	x	x	x	x	x
Refractory Materials	x		x	x	
Semiconductors	x	x	x	x	
Silicates	x				
Silicon	x	x	x		x
Silver	x			x	
Steel-Engineering	x	x	x	x	x
Steel-Maraging		x	x		
Steel-Stainless	x	x	x	x	x
Strontium Titanate	x				
Sulfides	x	x	x	x	
Tantalum	x	x	x	x	
Tin	x	x		x	
Titanium	x	x	x	x	
Tungsten	x	x		x	
Vanadium				x	
Water Coatings	x				
Yttrium Orthovanadate	x				
Zinc	x	x		x	
Zirconium	x				

(1) Surface effects, surface damage, optical properties, physical properties.
(2) Microstructural changes, phase transformation, bulk damage, destruction.

TABLE 2. EQUIVALENT DESIGNATIONS FOR INDEXED MATERIALS

Reported Designations	Indexed Designations
Aluminum	
14S	2014
24S	2024
61S	6061
75S	7075
78S	7078
Cobalt	
Stellite 25	L-605
Nickel	
A-Nickel	Nickel 200
Inconel	Inconel 600
Titanium	
RC-70A	Unalloyed Titanium
B120VCA	Ti-13V-11Cr-3Al
C110M	Ti-5.8Mn
A110AT	Ti-5Al-2.5Sn
140A	Ti-1.8Cr-1.5Mo-1.8Fe (Ti-2Cr-2Mo-2Fe)
RC-130A	Ti-7.8Mn
RS-120	Ti-6Al-4V
Others	
Calcium Carbonate	Calcite
Silver Arsenite	Proustite
Sapphire	Oxides
Ruby	Oxides

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1948

1. Cross, H. C., McMaster, R. C., et al., "Short-Time, High Temperature Properties of Heat-Resisting Alloy Sheet", Technical Report RA-15077, Battelle Memorial Institute (February 27, 1948).

   Stainless steel; 18/8 stainless; AISI 347; 19-9 DL; 25Cr-20Ni-2Si; engineering steel; AISI 4130; nickel alloys; Inconel 600; Hastelloy C; cobalt alloys; HS21; rapid heating; short time; elevated temperature; ultimate tensile strength; tensile yield strength; elongation; modulus of elasticity; stress-strain data; thermal expansion; deformation

1949

2. Simmons, W. F., Van Echo, J. A., et al., "Short-Time, High-Temperature Properties of Heat-Resisting Alloy Sheet", Technical Report R-147, Battelle Memorial Institute (June 1949).

   Magnesium alloys; Mg-3Al-1Zn; Mg-1Mn; aluminum; aluminum alloys; 7075; Armco Iron; engineering steel; AISI 4130; stainless steel; 18/8 stainless; AISI 347; 25Cr-20Ni-2Si; nickel alloys; Inconel 600; Inconel X-750; Hastelloy B; Hastelloy C; cobalt alloys; HS21; short time; elevated temperature; rapid heating; stress; deformation; elongation; creep rupture strength; ultimate tensile strength; tensile yield strength; thermal expansion

1951

3. Van Echo, J. A., Page, L. C., et al., "Short-Time Creep Properties of Structural Sheet Materials for Aircraft", Air Force Technical Report 6731 - Part I, Battelle Memorial Institute, Contract AF 33(038)-8743 (December 1951).

   Magnesium alloys; aluminum alloys; 2024-T3; 2024-T86; 7075-T6; engineering steel; AISI 1010; cobalt alloys; L-605; rapid heating; short time; elevated temperature; tensile properties; creep properties; deformation

1952

4. Smith, W. K., Woolsey, C. C., Jr., and Wetmore, W. O., "Effect of High Heating Rates on High-Temperature Properties", Transactions of the American Society for Metals, 44, 689-704 (1952).

   Engineering steel; AISI 1020; AISI 4130; aluminum alloys; 2014-T6; 2024-T4; 7075-T6; rapid heating; short time; elevated temperature; tensile properties; elongation; tensile yield strength; ultimate tensile strength; stress-strain data

1954

5. Feuerstein, W. J., and Smith, W. K., "Elevation of Critical Temperatures in Steel by High Heating Rates", Transactions of the American Society for Metals, 46, 1270-1284 (1954).

Engineering steel; AISI 1020; AISI 1042; AISI 1080; AISI 4130; rapid heating; short time; elevated temperature; tensile properties; elongation; plastic deformation

6. Van Echo, J. A., Wirth, W. F., et al., "Short-Time Creep Properties of Structural Sheet Materials for Aircraft", WADC Technical Report 6731 - Part III, Battelle Memorial Institute, Contract AF 33(038)-8743 (October 1954).

Titanium alloys; Ti-8Mn; aluminum alloys; 78S-T6; 24S-T81; 14S-T6; engineering steel; AISI 8630; AISI 4340; stainless steel; AISI 321; 17-7PH; iron alloys; Fe-3Cr-1Mo; rapid heating; short time; elevated temperature; creep test; tensile properties

1955

7. Dotson, C. L., and Kattus, J. R., "Tensile Properties of Aircraft Structural Metals at Various Rates of Loading After Rapid Heating", WADC Technical Report 55-199, Part I, Southern Research Institute, Contract AF 33(616)-424 (August 1955). (AD 090 524)

Stainless steel; AISI 321; aluminum alloys; 2014-T6; 2024-T3; 7075-T6; magnesium alloys; AZ31; titanium alloys; Ti-8Mn; titanium; rapid heating; short time; elevated temperature; stress-strain data; ultimate tensile strength; tensile yield strength; elongation; modulus of elasticity

8. Heimerl, G. J., and Inge, J. E., "Tensile Properties of 7075-T6 and 2024-T3 Aluminum-Alloy Sheet Heated at Uniform Temperature Rates Under Constant Load", National Advisory Committee for Aeronautics Technical Note NACA TN 3462 (July 1955).

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Aluminum alloys; 2024-T3; 7075-T6; nickel alloys; Inconel 600; titanium alloys; Ti-6Al-4V; rapid heating; short time; elevated temperature; stress-strain data; tensile yield strength

10. Van Echo, J. A., Gullotti, D. V., et al., "Short-Time Creep Properties of Structural Sheet Materials for Aircraft and Missiles", Technical Report 6731, Part 4, Battelle Memorial Institute, Contract AF 33(038)-8743 (July 1955).

Stainless steel; 17-7PH; AISI 410; A-286; engineering steel; AISI 4130; titanium alloys; Ti-7.8Mn; aluminum alloys; 6061-T6; 7075-T6; short time; rapid heating; creep test; elongation; grain size; precipitation; recrystallization; ultimate tensile strength; tensile yield strength; deformation; thermal expansion

1956

11. Morrison, J. D., and Kattus, J. R., "Tensile Properties of Aircraft-Structural Metals at Various Rates of Loading After Rapid Heating", WADC Technical Report 55-199, Part 2, Southern Research Institute, Contract AF 33(616)-424 (November 1956). (AD 110 540)

    Cobalt alloys; L-605; engineering steel; AISI 1020; AISI 4130; nickel alloys; Inconel X-750; stainless steel; AISI 301; 17-7PH; titanium alloys; Ti-5Al-2Sn; Ti-2Cr-2Mo-2Fe; magnesium alloys; ZH62; aluminum alloys; 356-T6; rapid heating; short time; elevated temperature; strain rate; ultimate tensile strength; tensile yield strength; elongation; modulus of elasticity.

1957

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    Copper; iron; molybdenum; tantalum; graphite; rapid heating; short time; elevated temperature; stress-strain data; tensile properties; modulus of elasticity; creep deformation; creep rupture strength

1958

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    Stainless steel; AISI 410; rapid heating; short time; elevated temperature; ultimate tensile strength; tensile yield strength; elongation; modulus of elasticity

14. Mollica, R. J., "Very-Short-Time High Temperature Properties of Magnesium Alloy HM21XA and Titanium Alloy 6Al-4V. Revision 1", Technical Memorandum MT-M50J, Chrysler Corporation, Contract CWO 270286 and CWO 200120 (April 3, 1958).

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1959

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    Magnesium alloys; HK31A-H24; HM21A-T8; HM31XA; rapid heating; short time; elevated temperature; stress-strain data; tensile creep; creep properties; tensile properties

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1960

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    Titanium alloys; rapid heating; short time; elevated temperature; ultimate tensile strength; tensile yield strength; elongation; techniques; apparatus

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Stainless steel; 17-7PH; AISI 301; nickel alloys; Inconel X-750; rapid heating; short time; elevated temperature; stress-strain data; strain rate; tensile properties

1962

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1963

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1965

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1966

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Copper; single crystals; laser damage; cratering; defects; dislocations; plastic deformation; hardness

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1967

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Mirrors; dielectric coatings; lead oxide coatings; cryolite coatings; zinc sulfide coatings; magnesium fluoride coatings; lasereffect; damage threshold; stability

Niobium; brass; copper; stainless steel; aluminum; laser effect; damage threshold

Nickel coatings; quartz substrate; laser effect; damage threshold; electrical resistivity

Cast iron; laser effect; pitting; hardness

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Dielectric materials; laser effect; thermal properties; thermoelasticity; thermal conductivity; thermal stress

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Germanium; quartz substrate; laser effect; low temperature; liquid nitrogen environment; electrical properties; electrical resistivity

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Glass; laser effect; laser damage; surface studies; optical properties

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Cast iron; laser effect; surface studies; thermal shock; pitting

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Stainless steel; brass; aluminum; laser effect; surface studies; cratering; holes

Glass; ruby; alkali halides; polymers; polymethylmethacrylate; polystyrene; laser damage; cracking; damage threshold; photoconductivity; surface studies

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Cadmium sulfide; laser damage; cratering; cracking; absorption; oxidation; surface studies

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Aluminum alloys; 6061-T6; titanium; copper; electron beam heating; rapid heating; damage threshold; fracture; spalling; cracking; density; shear modulus; tensile yield strength; degradation

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Aluminum alloys; 2014-T6; titanium; rapid heating; electron beam heating; short time; elevated temperature; degradation; modulus of elasticity; tensile yield strength; penetration depth

134. Stefansky, T., et al., "Temperature-Induced Degradation of Mechanical Properties Following Instantaneous Heating", Report AFWL-TR-71-62, Physics International Co., Contract F29601-70-C-0011 (September 1971).

Aluminum alloys; 6061; resin matrix composites; rapid heating; elevated temperature; electron beam heating; strain rate; thermal degradation; ultimate tensile strength; tensile yield strength; modulus of elasticity

135. Sultanov, M. A., "Damage Caused to Polymer Films by Laser Radiation and its Relation to the Nature and Structure of the Material", Polymer Mechanics, 7 (6), 968-971 (November/December 1971). Translation of Mekhanika Polimerov, (6), 1092-1093 (1971).

Thin films; polymer coatings; polyethylene coatings; Dacron coatings; polypropylene coatings; Teflon coatings; Kapron coatings; surface studies; microstructure; physical properties; chemical properties; reflectivity; photolysis; explosion; shock waves; degradation; destruction

136. Triebes, K., Shea, J., and Stefansky, T., "Thermal Degradation of Mechanical Properties for 6Al-4V and 13V-11Cr-3Al Titanium Alloys", PIFR-336, Physics International Co., prepared for University of California, Lawrence Livermore Laboratory Contract No. P. O. 5472509 (August 1971).

Titanium alloys; Ti-6Al-4V; Ti-13V-11Cr-3Al; rapid heating; elevated temperature; thermal degradation; mechanical properties

137. Trink, S., "Laser Cutting Manufacturing Methods", Interim Engineering Progress Report IR-731-1(I), Grumman Aerospace Corporation, Contract F 33(615)-71-C-1949 (November 1971). (AD 178 699)

Ti-6Al-4V; Hastelloy X; Rene 41; TD-Nickel-Cr; Haynes 188; AISI 410; AISI 4340; Ti-6Al-6V-2Sn; laser cutting; heat affected zone; nondestructive test; microstructure

138. Turner, A. F., "Ruby Laser Damage Thresholds in Evaporated Thin Films and Multilayer Coatings", National Bureau of Standards Special Publication 356, 119-123 (1971).

Thin films; thorium fluoride coatings; silicon oxide coatings; magnesium fluoride coatings; aluminum oxide coatings; calcium fluoride coatings; zirconium oxide coatings; titanium oxide coatings; lithium fluoride coatings; magnesium oxide coatings; cerium oxide coatings; zinc sulfide coatings; laser damage; damage thresholds; surface studies

139. Voropay, Ye. S., and Sarzhevskiy, A. M., "Luminescence of Transparent Solid Materials Under the Action of Laser Radiation", Zhurnal Prikladnoy Spektroskopii, 14, 534-536 (1971).

Glass; quartz; Plexiglass; laser effect; surface studies; cratering; optical properties; luminescence

140. Wood, R. M., Tait, J. M., and Rouse, R. L., "Investigation of Dielectric Optical Coatings for Lasers", Annual Report 3, DRIC BR-28067, General Electric Company, Ltd., (December 1971). (AD 891 768)

Cerium oxide coatings; zinc sulfide coatings; thorium fluoride coatings; magnesium fluoride coatings; laser damage; dielectric properties; hardness; surface studies

141. Zakharov, V. P., Tsvirko, Yu. A., and Chugaev, V. N., "Recrystallization of Thin Semiconductor Films Under Laser Radiation", Protsessy Sinteza i Rosta Kristallov Plenok Poluprovodnikoriykh Materialov Simpozium, 270-273 (1971).

Thin films; semiconductor materials; germanium; laser effect; recrystallization; microstructure

142. Zhiryakov, B. M., Rykalin, N. N., Uglov, A. A., et al., "Characteristics of the Damage Imparted to Metals by a Focused Laser Beam", Zhurnal Tekhnicheskoy Fiziki, 41 (5), 1037-1042 (May 1971).

Zirconium; laser effect; surface studies; cratering; surface removal; melting

143. Zhukov, A. A., and Krishtal, M. A. "Transformations in Cementite Under a High Rate of Heating and Quench Hardening", Liteynoye Proizvodstvo, (5), 34-36 (1971).

Iron carbide; laser effect; microstructure; phase transformations; heating; cooling; quenching; hardening

1972

144. "Thermophysical Characterization of Advanced Materials Under Transient Heating Conditions", Third Quarterly Report, General Electric Company, Contract NAS 1-10805 (March 1972). (AD 179 079)

Graphite; phenolics; rapid heating; short time; thermal expansion; thermal conductivity

145. Aboelfotoh, M. O. and Von Gutfeld, R. J., "Effects of Pulsed Laser Radiation on Thin Aluminum Films", Journal of Applied Physics, 43 (9), 3789-3794 (1972).

Thin films; aluminum coatings; Mylar substrates; laser effect; laser damage; surface studies

146. Akulenok, E. M., Danileiko, Yu. K., et al., "Mechanism of the Destruction of Ruby Crystals by Laser Radiation", Pis'ma Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki, 16 (6), 336-339 (1972).

Ruby; aluminum oxide; single crystals; laser damage; destructive test

147. Anderholm, N. C., and Anderson, P. D., "Laser-Heating Studies of Composite Materials", Journal of Applied Physics, 43 (4), 1820-1825 (1972).

Fiber reinforced composites; resin matrix composites; carbon/resin composite; polymethylmethacrylate; polyethylene; laser effect; heating; microstructure; crystal structure

148. Arkhipov, Yu. V., Morachevskii, N. V., Morozov, V. V., et al., "Energy Balance and Destruction Dynamics of Transparent Dielectrics During Laser Irradiation", Fizika Tverdago Tela (Leningrad), 14 (6), 1756-1760 (1972).

Dielectric materials; glass; quartz; laser effect; laser damage; destructive test

149. Austin, R. R., Michaud, R. C., Guenther, A. H., et al., "Influence of Structural Effect on Laser Damage Thresholds of Discrete and Inhomogeneous Thin Films and Multilayers", National Bureau of Standards Special Publication 372, 135-164 (1972).

Thin films; silicon oxide coatings; zinc sulfide coatings; fluoride coatings; magnesium difluoride coatings; thorium tetrafluoride coatings; laser damage; damage threshold; microstructure

150. Avotin, S. S., Krivchikova, E. P., Papirov, I. I., et al., "Alteration of the Electric Resistance of Laser Irradiated Beryllium", Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki, 62 (1), 288-293 (1972).

Thin films; foils; beryllium; laser effect; electrical properties; electrical resistivity

151. Bass, M., and Barrett, H. H., "Laser-Induced Damage Probability at 1.06 and 0.69 Microns", National Bureau of Standards Special Publication 372, 58-69 (1972).

Dielectric materials; potassium phosphate; quartz; lithium niobate; lithium iodate; strontium titanate; laser damage; surface studies

152. Bates, R. D., Jr., Cook, C. F., Jr., Shappirio, J. R., et al., "Interaction of Semiconductor Materials with Laser Radiation at 10.6 Micrometers", Technical Report ECOM-4059, U.S. Army Electronics Command (December 1972).

Semiconductor materials; silicon; laser effect; laser damage; surface studies; pitting; surface roughness; cracking; holes; deformation

153. Bedilov, M. R., Khaidarov, K., and Babadzhanova, Kh., "Nature of Radiation Defects Formed on the Surface of Solids by Ruby Laser Radiation", Izvestiya Akademii Nauk Uzbekskoy SSR, Seriya Fiziko Matematichekikh Nauk, 16 (2), 66-68 (1972).

Tungsten; molybdenum; nickel; zinc; silicon; laser effect; surface studies; defects

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Glass; ruby; sapphire; quartz; dielectric materials; laser effect; laser damage; damage threshold; microcracking; cratering; thermal conductivity; thermal properties; surface studies

155. Bertolotti, M., Sette, D., Stagni, L., et al., "Electron Microscope Observation of Laser Damage on Gallium Arsenide, Gallium Antimonide, and Indium Antimonide", Radiation Effects, 16 (3-4), 197-202 (1972).

Gallium arsenide; gallium antimonide; indium antimonide; laser effect; laser damage; microstructure

156. Bliss, E. S., Milam, D., and Bradbury, R. A., "Laser Induced Damage to Mirrors at Two Pulse Durations", Technical Report No. 2, AFCRL-72-0423, Air Force Cambridge Research Laboratories (July 1972).

Dielectric materials; mirrors; titanium oxide coatings; zirconium oxide coatings; zinc sulfide coatings; silicon oxide substrates; thorium fluoride substrates; laser damage; fogging; damage threshold; absorption; defects; surface studies

157. Boling, N. L., and Dube, G., "Laser-Induced Damage to Glass Surfaces", National Bureau of Standards Special Publication 372, 40-45 (1972).

Glass; laser damage; damage threshold; surface studies

158. Boling, N. L., and Dube, G., "Damage Threshold Studies of Glass Laser Materials", Semi-Annual Technical Report, Owens-Illinois Inc., Contract DAHC15-72-C-0170 (December 1972).

Laser materials; dielectric materials; glasses; laser damage; damage threshold; surface studies; measurement

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Aluminum alloys; engineering steel; laser effect; fatigue tests; fracture mechanics; embrittlement; crack nucleation

160. Condell, W. J., "Laser Damage of Optical Elements", Technical Report ONRL-M-3-72, Office of Naval Research, London (October 1972). (AD 906 565L)

Mirrors; optical coatings; laser damage; surface studies

161. Edwards, D. F., and She, C. Y., "Laser Produced Damage in Transparent Solids", Technical Report, Colorado State University (1972). (AD 740 951)

Quartz; laser damage; damage threshold; surface studies; microstructure

162. Eleiche, A.S.M., "A Literature Survey of the Combined Effects of Strain Rate and Elevated Temperature on the Mechanical Properties of Metals", Report AFML-TR-72-125, Brown University, Contract F 33(615)-71-C-1308 (September 1972).

Aluminum; aluminum alloys; 1100 aluminum; 2024; 5052; 6061; 7075; beryllium alloys; I-400; S-200E; copper; copper alloys; Cu-20Zn (brass); Cu-5Sn (bronze); iron; magnesium; molybdenum; nickel; niobium; engineering steel; stainless steel; 18/8 stainless; AISI 316; titanium alloys; Ti-6Al-4V; rapid heating; short time; elevated temperature; strain rate; stress-strain data; compressive properties; tensile properties; ultimate tensile strength; reduction in area; elongation; ductility; modulus of elasticity; fracture

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Aluminum alloys; 7075-T73; laser effect; microstructure; ultimate tensile strength; tensile yield strength; elongation; strengthening; shock hardening; dislocations

164. Feldman, A., Horowitz, D., and Waxler, R. M., "Laser Damage in Materials", Semi-Annual Report, NBS 10894, National Bureau of Standards (July 1972). (AD 747 290)

Glass; borosilicate glass; fused silica; flint glass; laser damage; damage threshold; surface studies

165. Field, J. E., and Zafar, M. A., "Effect of Surface Films on Laser Damage in Glasses", Journal of Physics D, 5 (11), 2105-2114 (1972).

Glass substrates; carbon coatings; laser damage; surface studies

166. Fradin, D. W., Yablonovitch, E., and Bass, M., "Comparison of Laser Induced Bulk Damage in Alkali-Halides at 10.6, 1.06, and 0.69 Microns", National Bureau of Standards Special Publication 372, 27-39 (1972).

Alkali halides; laser damage; microstructure; bulk damage; surface studies; surface damage

167. Gilbert, K. G., and Reinke, R., "Rapid Laser Heating of Metals Under Constant Uniaxial Stress", Report AFWL-TR-72-12, Air Force Weapons Laboratory, Kirtland AFB, New Mexico (May 1972). (AD 900 865L)

Aluminum alloys; magnesium alloys; stainless steel; laser effect; mechanical properties; tensile properties; thermodynamic properties

168. Giuliano, C. R., and Tseng, D. Y., "Laser Induced Damage to Nonlinear Optical Materials", Technical Report AFCRL-72-0455, Hughes Aircraft Company, Hughes Research Laboratory, Contract F 33(615)-71-C-1715 (September 1972). (AD 748 935)

Optical materials; lithium iodate; proustite; laser damage; damage threshold; surface studies

169. Giuliano, C. R., "Laser-Induced Damage in Transparent Dielectrics. Ion Beam Polishing as a Means of Increasing Surface Damage Thresholds", Physics Letters, 21 (1), 39-41 (1972).

Dielectric materials; sapphire; laser damage; surface studies

170. Giuliano, C. R., "Laser-Induced Damage in Transparent Dielectrics. Relation Between Surface Damage and Surface Plasmas", IEEE Journal Quantum Electronics, 8 (9), 749-754 (1972).

Dielectric materials; laser damage; surface studies

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Engineering steel; iron; laser effect; physical properties; mechanical properties; microstructure; wear

172. Gridnev, V. N., Ivasishin, O. M., et al., "Inheritance of Alpha-Phase Defect Structure by Austenite During the Rapid Heating of U9 Carbon Steel", Metallofizika, No. 39, 69-75 (1972).

Engineering steel; carbon steel; Russian alloys; U-9; rapid heating; phase transformation; microstructure; deformation

173. Griffin, R. B., and Pepe, J., "Rapidly Austenitized Low Carbon Steel", Technical Report WVT-7252, Watervliet Arsenal (October 1972). (AD 180 903)

Engineering steel; AISI 1010; rapid heating; elevated temperature; short time; metallography; phase transformation; microstructure; phase diagrams

174. Grigoriew, H., "Electron-Microscopic Studies of Structural Changes in Glass Irradiated by Neodymium Laser", Szkloi Ceramika, 23 (3), 72-77 (1972).

Glass; laser effect; microstructure

175. Gryaznov, I. M., Kovalev, A. A., Mirkin, L. I., et al., "Melt Zones and Thermal Effect in Metals During the Action of Laser Radiation of Different Duration", Fizika i Khimiya Obrabotki Materialov, (5), 8-10 (1972).

Iron alloys; Armco iron; engineering steel; 45 steel; Russian alloys; laser effect; heat affected zone; melting; surface studies; microstructure

176. Gulyaeva, A. S., Krasyuk, B. A., Maslov, V. N., et al., "Change in the Photoluminescence of Gallium Arsenide Single Crystals in Regions Damaged by a Laser Beam", Doklady Akademii Nauk SSR, 205 (4), 815-817 (1972).

Gallium arsenide; single crystals; laser damage; surface studies; photoluminescence

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Aluminum; thin films; laser effect; laser damage; microstructure; vaporization; grain growth; grain size; melting; plastic deformation; electromigration; thermal gradients

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Laser materials; window materials; sodium chloride; laser damage; damage thresholds; surface studies

179. Lipkin, J., et al., "Mechanical Properties of 6061-T6 Aluminum After Rapid Heating", Report SC-RR-72-0020, Sandia Laboratories (March 1972).

Aluminum alloys; 6061-T6; rapid heating; mechanical properties

180. Litvinov, V. S., and Pantsyreva, E. G., "Features of the Deformation and Fracture of Ni-Al Compounds Due to Large Thermal Pulses", Russian Metallurgy, (4), 130-133 (1972).

Nickel aluminide; nickel compounds; intermetallic compounds; laser effect; cratering; microcracking; plastic deformation; thermal shock; martensite transformation; microhardness; surface studies; physical properties

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Ceramic materials; rapid heating; spalling; cracking; shear stress; failure; surface studies

182. Ng, R., and Butcher, B. M., "The Dynamic Response of Heated Porous Aluminum", Technical Report SC-RR-710790, Sandia Laboratories (January 1972). (AD 181 104)

Aluminum alloys; 2024; fused silica; rapid heating; electron beam heating; softening; density; melting; spalling; surface studies

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Iron; engineering steel; laser effect; surface removal; thermal diffusivity; thermal conductivity; cratering; fracture; surface studies

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Silicate glasses; polymethylmethacrylate; laser effect; cracking; overheating; degradation; surface studies; microstructure

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Iron alloys; stainless steel; 1Kh18N8; engineering steel; 30Kh10G10; laser effect; surface studies; cratering; hardening, deformation; microstructure; phase transformation; microhardness

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Laser window materials; alkali halides; chalcogenides; potassium chloride; cadmium telluride; zinc selenide; thin films; laser effect; optical properties; mechanical properties; thermal properties

187. Pitha, C. A., "Conference on High Power Infrared Laser Window Materials October 30, 31, and November 1, 1972. Volume II", Special Report AFCRL-SR-Vol-2, AFCRL-TR-73-0372(I) (November 1972). (AD 914 501L)

Laser window materials; alkali halides; chalcogenides; potassium chloride; cadmium telluride; zinc selenide; thin films; laser effect; strengthening; surface studies; optical properties; mechanical properties; thermal properties

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Thin films; gold coatings; quartz substrates; laser damage; surface studies; reflectivity

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Iron alloys; engineering steel; ST-45; U-8; ShKh-15; KhVG; Kh12M; laser effect; particle distribution; dislocations; microstructure; destructive test

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Ceramic materials; refractory compounds; carbides; nitrides; borides; oxides; rapid heating; elevated temperature; thermal shock; thermal fatigue; density; porosity; thermal expansion; thermal conductivity; bend strength; modulus of elasticity

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Engineering steel; Russian alloys; 18KhNVA;37KhN3A; 37KhN3M; 40Kh13; rapid heating; elevated temperature; metallography; grain size; recrystallization; microstructure

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Polymers; polystyrene; laser damage; damage threshold; surface studies

193. Smith, J. L., "Damage to Gallium Arsenide Surfaces From Ruby and Neodymium Glass Laser Illumination", National Bureau of Standards Special Publication 372, 70-74 (1972).

Gallium arsenide; laser damage; surface studies

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Aluminum alloys; 6061-T6; fiber reinforced composites; quartz/phenolic composite; rapid heating; electron beam heating; short time; elevated temperature; thermal shock; ultimate tensile strength; tensile yield strength; modulus of elasticity; measurement; degradation; compressive strength

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Engineering steel; 30KhGSA; laser effect; interlayers; physical properties

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Rene 41; Hastelloy X; Haynes 188; TD-nickel-Cr; Ti-6Al-4V; Ti-6Al-6V-2Sn; AISI 410; AISI 4340; laser cutting; fatigue properties; tensile properties

197. Trink, S., "Laser Cutting Manufacturing Methods", Interim Engineering Progress Report IR-731-1(III), Grumman Aerospace Corporation, Contract F 33(615)-71-C-1949 (April 1972). (AD 179 574)

AISI 4340; AISI 410; Hastelloy X; Rene 41; TD-nickel-Cr; Haynes 188; Ti-6Al-4V; Ti-6Al-6V-2Sn; laser cutting; heat affected zone; tensile test; tensile properties

198. Uglov, A. A., Zhukov, A. A., Krishtal, M. A., and Shorshorov, M. Kh., "Displacement of the Critical Points on Heating Iron-Carbon Alloys With Laser Radiation", Fizika i Khimiya Obrabotki Materialov, (2), 3-8 (March-April 1972).

Iron alloys; carbon steel; laser effect; heating; phase transformations; thermal analysis; microhardness; microstructure

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Carbon; laser effect; heating; microstructure; crystal structure; twinning; density; transparency

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Stainless steel; AISI 304; aluminum alloys; nickel; laser effect; surface studies; absorption; reflectivity; electrical properties; electrical conductivity

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Armco iron; carbon steel; laser effect; phase transformation; microstructure

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202. "Action of Concentrated Laser Radiation on Thin Films", Spektroskiya Trudy Sibirskiy Soveshcheniya 6th 1968, 38-40 (1973).

Copper coatings; chromium coatings; germanium coatings; aluminum coatings; iron coatings; nickel coatings; thin films; silica substrates; surface tension; surface studies

203. Allingham, C. O., Cutter, M. A., Key, P. Y., et al., "Damage to a Transparent Substrate by Laser Light Absorption in a Thin Film", Journal of Physics D, 6 (1), 1-5 (1973).

Thin films; gold coatings; transparent substrates; laser effect; laser damage; surface studies

204. Alyassini, N., Parks, J. H., and DeShazer, L. G., "Time Resolution of Laser Induced Damage to Thin Films", National Bureau of Standards Special Publication 387, 133-137 (1973).

Zinc sulfide coatings; thin films; damage; time; reflectivity; surface studies

205. Ammann, E. O., and Wintemute, J. D., "Damage to Zinc Sulfide Thin Films From 1.08 μm Laser Radiation", Journal of the Optical Society of America, 63 (8), 965-970 (1973).

Thin films; zinc sulfide coatings; laser damage; surface studies

206. Austin, C. W., Jr., "Mechanical Behavior of 18Ni (300) Maraging Steel During Rapid Heating and at Elevated Temperatures", Technical Report RL-73-10, Redstone Arsenal (December 12, 1973). (AD 773 732)

Maraging (300); loading; rapid heating; heating rate; short time; elevated temperature; tensile yield strength; strain rate; 1200 F

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Thin films; magnesium fluoride coatings; silicon dioxide coatings; fused silica substrates; laser effect; damage threshold; compressive strength; ultimate tensile strength; surface studies; refractive index

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Aluminum alloys; 6061-T651; rapid heating; short time; elevated temperature; strain rate; metallography; tensile properties; tensile yield strength

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Carbon steel; engineering steel; surface studies; laser effect; hardening; penetration depth; microhardness; phase transformation; microstructure

210. Bass, M., Fradin, D. W., and Holway, L. H., Jr., "Experimental and Investigation of Optical-Irradiation-Induced Surface Damage in Optically Nonlinear Materials", Final Report, AFCRL-72-0714, Raytheon Company, Contract F 19(628)-70-C-0223 (February 1973).

Optical materials; sodium chloride; fused quartz; strontium titanate; sodium fluoride; rubidium chloride; alkali halides; laser damage; damage threshold; surface studies; pitting; cracking; holes

211. Bass, M., Fradin, D. W., and Bua, D. P., "Visible and Infrared Laser-Induced Damage to Transparent Materials", Semiannual Technical Report AFCRL-TR-73-0494, Raytheon Company, Contract F 19(628)-73-C-0127 (September 1973).

Laser window materials; fused silica; dielectric coatings; laser damage; measurement; damage threshold; surface studies

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Cesium iodide; laser damage; surface studies

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Dielectric materials; mirrors; titanium oxide coatings; silicon oxide coatings; zirconium oxide coatings; zinc sulfide coatings; thorium fluoride coatings; laser effect; laser damage; morphology; pitting; damage threshold; measurement; surface studies

214. Bloembergen, N., "Role of Cracks, Pores, and Absorbing Inclusions on Laser Damage Threshold at Surfaces of Transparent Dielectrics", Applied Optics, 12 (4), 661-664 (April 1973).

Transparent materials; dielectric materials; alkali halides; glasses; aluminum oxide; zinc selenide; cadmium telluride; chalcogenide glasses; laser effect; damage threshold; surface studies; cracks; pores; refractive index; thermal stress

215. Boling, N. L., Crisp, M. D., and Dube, G., "Laser Induced Surface Damage", Applied Optics, 12 (4), 650-660 (April 1973).

Transparent materials; dielectric materials; glass; laser effect; damage threshold; surface studies; refractive index; pitting; morphology; cracking

216. Boling, N. L., and Dube, G., "Laser-Induced Inclusion Damage at Surfaces of Transparent Dielectrics", Applied Physics Letters, 23 (12), 658-660 (1973).

Dielectric materials; laser damage; damage threshold; surface studies; absorption

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Glasses; sapphire; aluminum oxide; laser damage; surface studies; damage threshold; surface roughness

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Aluminum; engineering steel; laser damage; spalling; fragmenting; surface studies

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Optical materials; dielectric materials; lithium niobate; sodium chloride; lithium fluoride; laser damage; damage threshold; surface studies

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Potassium chloride; zinc selenide; cadmium telluride; laser windows; laser damage; arsenic sulfide coatings; barium fluoride coatings; thorium fluoride coatings; zinc sulfide coatings; damage threshold; failure; design; surface studies

221. Burdin, V. V., Grabenko, N. M., Gridnev, V. N., et al., "Formation of Austenite Below the Phase Equilibrium Temperature During the Rapid Heating of Carbon Steels", Physics of Metals and Metallography, 35 (3), 94-101 (1973).

Carbon steel; engineering steel; Russian alloys; austenite; rapid heating; heating rate; phase transformations; microstructure

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Aluminum alloys; copper alloys; nickel alloys; silicon alloys; laser effect; X-ray analysis; microstructure; microhardness; surface roughness

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Thin films; titanium oxide coatings; silicon oxide coatings; zirconium oxide coatings; magnesium fluoride coatings; zinc sulfide coatings; dielectric coatings; glass substrates; fused silica substrates; sodium chloride substrates; magnesium aluminate substrates; laser damage; damage threshold; surface studies

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Glass; fused silica; laser damage; damage threshold; electrostriction; refractive index; surface studies

225. Feldman, A., Horowitz, D., and Waxler, R. M., "Laser Damage in Materials", Semi-Annual Technical Report NBSIR-73-268, National Bureau of Standards (August 1973). (AD 768 303)

Lithium niobate; calcite; potassium phosphate; laser damage; damage threshold; electrostriction; refractive index; thermal stress; microcracking

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Aluminum alloys; 6061-T6; Plexiglas; laser effect; spalling; surface studies; absorption; surface removal

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Fused quartz; sapphire; glass; laser damage; damage threshold; pitting; cracking; voids; grooving; surface studies; microstructure

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Alkali halides; sodium iodide; potassium iodide; rubidium iodide; sodium bromide; potassium bromide; rubidium bromide; sodium chloride; potassium chloride; rubidium chloride; sodium fluoride; potassium fluoride; laser effect; damage threshold; refractive index; breakdown strength; microstructure

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Alkali halides; sodium chloride; quartz; sodium fluoride; laser damage; surface studies; optical properties; damage threshold; theory

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Beryllium; rapid heating; electron beam heating; elevated temperature; stress-strain data; fatigue properties; degradation; tensile properties; hardness; grain structure

231. Giuliano, C. R., "Laser-Induced Damage in Optical Materials", Semiannual Technical Report, AFCRL TR-73-0099, Hughes Research Laboratories, Contract F 19(628)-72-C-0348 (January 1973). (AD 760 131)

Optical materials; sapphire; aluminum oxide; proustite; laser damage; surface studies; damage threshold; cratering; melting

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Optical materials; proustite; aluminum oxide; sapphire; lithium niobate; laser damage; damage threshold; surface studies; chemical properties; decomposition; cratering

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Laser materials; optical materials; infrared windows; mirrors; optical coatings; laser damage; damage threshold; absorption; surface studies

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Dielectric materials; thin films; laser damage; damage threshold; surface studies; review

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Engineering steel; steel 70; Russian alloys; rapid heating; short time; elevated temperature; thermal resistance; phase transformation; deformation; recrystallization; microstructure

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Gallium arsenide; laser effect; microstructure; dislocations

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Thin films; semiconductor coatings; dielectric substrates; laser effect; damage threshold; destructive test

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Metal matrix composites; W/NiCr composite; laminates; rapid heating; thermal cycling; thermal expansion; elastic-plastic stresses; modulus of elasticity

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Maraging (250); Maraging (300); rapid heating; short time; elevated temperature; strain rate; ultimate tensile strength; tensile yield strength; elongation; modulus of elasticity; fracture; stress-strain data

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Aluminum alloys; 2024; laser effect; fatigue properties; residual stresses; ultimate tensile strength; thermal shock; strain hardening

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Engineering steel; stainless steel; Russian alloys; 1Kh18N9T; ST-45; ST-3; Kh12M; 35KhG; 40KhG; U-8; Sh-15; E1943; E1627; laser effect; heating; cooling; heat affected zone; microstructure; composition; thermal properties; book

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Infrared window materials; semiconductor materials; alkali halides; gallium arsenide; laser damage; mechanical properties; optical properties; thermal properties

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Aluminum alloys; 6061-T6; rapid heating; short time; elevated temperature; electron beam heating; strain rate; tensile properties; tensile yield strength; shear modulus; modulus of elasticity; plastic deformation

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Dielectric materials; glass; sodium chloride; potassium chloride; potassium bromide; alkali halides; laser damage; damage threshold; surface studies; absorption

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Optical materials; yttrium orthovanadate; calcite; crystal growth; single crystals; laser damage; damage threshold; surface studies; melting; refractive index

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Germanium; laser effect; low temperature; electrical resistivity

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Iron alloys; refractory metals; copper alloys; Cu-15Pt; tungsten; carbides; laser effect; cratering; deformation; cracking; destruction

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Thin films; beryllium coatings; glass substrates; laser damage; melting; evaporation; degradation; thermal gradients; thermal response; surface studies; surface roughness

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Transparent materials; dielectric materials; polymers; Plexiglas; polymethylmethacrylate; laser effect; damage threshold; cracking; degradation; gasification; surface studies

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Aluminum alloys; 6061; stainless steel; deformation; microstructure

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Polymers; laser effect; surface studies; cracking; thermoelasticity

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Lithium niobate; laser damage; surface studies; refractive index; contamination; absorption; optical properties

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Gallium arsenide; zinc telluride; semiconductors; laser effect; damage threshold; surface studies; pitting; thickness; refractive index

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Aluminum alloys; 2024; stainless steel; AISI 304; graphite; fiberglass/epoxy composite; aluminum oxide; magnesium oxide; ceramic materials; laser effect; absorption; thermal coupling; vaporization; surface studies

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Magnesium alloys; AZ31B; aluminum alloys; 2024; titanium alloys; Ti-6Al-4V; stainless steel; AISI 304; laser effect; heating; melting; burn-through data; surface studies; absorption; thermal response; specific heat; thermal conductivity

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Permalloy; iron alloys; nickel addition; thin films; laser effect; crystal structure

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Thin films; dielectric coatings; cadmium telluride coatings; thorium fluoride coatings; zinc telluride coatings; zinc sulfide coatings; arsenic selenide coatings; potassium chloride coatings; mirror substrates; laser damage; damage threshold; measurement; surface studies

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Ceramic materials; glass; polymers; laser damage; surface studies; cracking; brittleness; degradation; theory

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Glass; quartz; Plexiglas; polystyrene; laser effect; surface studies; vaporization; cratering; cracking; fracture; holes; review

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Iron; iron alloys; engineering steel; nitrogen addition; carbon addition; aluminum addition; laser effect; hardening; embrittlement; grain size; heat treating; microstructure; electrical resistivity; damping

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Glass substrates; metals; water coatings; laser effect; mechanical shock; impact properties; holes; surface studies

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Alkali halides; laser effect; fracture; plastic deformation; shock waves; surface studies

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Mirrors; optical materials; laser damage; surface studies; optical properties

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Laser materials; glasses; fused quartz; laser damage; damage threshold; contaminants; surface studies; finishing; coatings; refractive index

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Laser window materials; barium fluoride; zinc selenide; zinc sulfide; arsenic sulfide; thorium fluoride; thin films; laser effect; chemical properties; physical properties; mechanical properties; literature survey

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Laser window materials; alkali halides; potassium chloride; potassium bromide; single crystals; laser damage; crystal growth; mechanical properties; optical properties; defects; strengthening; tensile yield strength; hardness; flow properties

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Aluminum alloys; 6061-T6; graphite; rings; electron beam heating; thermal loading; surface studies; penetration depth; distortion

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Silver coatings; gold coatings; aluminum coatings; thin films; glass substrates; laser effect; laser damage; etching; surface studies

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Molybdenum alloys; rapid heating; crystal structure; phase transformation

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Iron; iron alloys; Fe-3Si; laser effect; stress waves; microstructure

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Zinc selenide; arsenic sulfide; chalcogenides; glass; potassium chloride; laser effect; heating; absorption; surface studies; optical properties; distortion; refractive index; thermal expansion

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Polymers; polymethylmethacrylate; dielectric materials; laser damage; damage threshold; surface studies

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Aluminum alloys; 6061-T6; laser effect; spalling; surface studies

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Aluminum alloys; 6061-T6; laser effect; stress-wave activity; surface studies

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Quartz; zinc selenide; alkali halides; laser damage; damage threshold; optical properties; surface studies; crystal structure

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Unalloyed aluminum; aluminum alloys; 7075-T6; electron beam heating; laser effect; surface studies; melting; cracking; intergranular fracture; microstructure; spalling

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Gold coatings; titanium coatings; polyethylene; thin films; foil; wire; laser effect; surface studies; melting; holes; spalling; shock waves; cavitation; fracture

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Iron; rapid heating; superplasticity; phase transformation; strain rate; grain size; microstructure

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Engineering steel; carbon steel; rapid heating; elevated temperature; deformation; microstructure

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Strontium fluoride; laser window materials; radiation effect; microstructure; dislocations; cleavage; hardness; fracture

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Laser window materials; semiconductor materials; alkali halides; surface studies; infrared heating; rapid heating; mechanical properties; optical properties; thermal properties

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Laser window materials; semiconductor materials; zinc selenide; potassium chloride; alkali halides; mechanical properties; thermal properties; refractive index; absorption

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Aluminum; 1100 aluminum; laser effect; spalling; stress; surface removal; absorption; surface studies

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Titanium oxide; yttrium orthovanadate; single crystals; laser damage; surface studies; surface defects; damage threshold; crystal structure

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Aluminum alloys; 6061-T6; short time; rapid heating; elevated temperature; tensile yield strength; elastic-plastic stresses; spalling; fracture

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Silicon; solar cells; copper addition; laser damage; surface studies; melting; cracking; degradation; photoelectric properties

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Unalloyed aluminum; stainless steel; laser damage; computer programming; surface studies; burn-through data; thickness; time

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Engineering steel; rapid heating; phase transformation; grain growth; microstructure; TTT diagrams

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Dielectric materials; alkali halides; potassium chloride; sodium chloride; zinc selenide; cadmium telluride; gallium arsenide; laser damage; surface studies; surface damage; bulk damage

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Zinc selenide; laser damage; crystal structure; twinning

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Mirrors; dielectric coatings; laser damage; damage threshold; surface studies

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Magnesium alloys; AZ31; aluminum alloys; 2024-T6; stainless steel; AISI 304; electron-beam heating; rapid heating; short time; elevated temperature; surface studies; viscoelasticity; spalling; density; modulus of elasticity; Poisson's ratio; shear modulus; ultimate tensile strength

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Silicon nitrides; laser effect; heating; crack propagation; notch sensitivity; surface studies; acoustic emission technique; thermal shock; bend properties; fatigue properties; fracture toughness; destructive test

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Zinc selenide; sodium chloride; mirrors; laser damage; damage threshold; surface studies

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Silicon nitride; ceramic materials; radomes; thermal shock; dielectric properties; flexure strength; modulus of elasticity; Poisson's ratio; thermal conductivity; thermal expansion; specific heat; density

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Thin films; zinc selenide coatings; arsenic selenide coatings; thorium fluoride coatings; potassium chloride substrates; copper; laser damage; damage threshold; surface studies; absorption

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Aluminum; laser effect; spalling; deformation; failure; microstructure

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Gold coatings; quartz substrates; aluminum; nickel; copper; tungsten; laser effect; thermal stress; surface studies; spalling; melting; plastic deformation; residual stresses

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Tin; zinc; nickel; titanium; laser effect; surface studies; melting; cratering; penetration depth

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Tungsten; laser effect; surface studies; penetration depth; absorption; time

308. Brewer, W. D., "Interaction of Graphite and Ablative Materials With CO_2-Laser, Carbon-Arc, and Xenon-Arc Radiation", Thesis, NASA TM-X-68726, George Washington University (May 1975). (N75-22385)

Graphite; carbon/resin composite; nylon; laser effect; cavitation; cracking; spalling; bending; degradation; surface studies

309. Dickinson, S. K., "Infrared Laser Window Materials Property Data for Zinc Selenide, Potassium Chloride, Sodium Chloride, Calcium Fluoride, Strontium Fluoride, Barium Fluoride", Technical Report AFCRL TR-75-0138 (June 1975). (AD/B 007 119L)

Zinc selenide; potassium chloride; sodium chloride; calcium fluoride; strontium fluoride; barium fluoride; laser damage; surface studies; melting; absorption; refractive index; thermal stability

310. Fox, J. A., and Barr, D. N., "The Effect of Short-Pulse Laser Radiation on Coatings", Technical Report USAMERDC-2138, Army Mobility Equipment Research and Development Center (April 1975). (AD/A 018 864).

Paint coatings; distilled water coatings; aluminum substrates; tin substrates; lead substrates; Plexiglas substrates; laser effect; laser damage; surface removal; vaporization; spalling; perforations; stress-wave activity; reflectivity; shock waves; surface studies

311. Ghez, R. A., "Laser Heating and Melting of Thin Films on Low-Conductivity Substrates", Journal of Applied Physics, 46 (5), 2103-2110 (May 1975).

Thin films; silicon; laser effect; surface studies; heating; melting

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Polyethylene; laser effect; shock waves; explosive test; destructive test

313. Hibben, S. G., Kourilo, J., Ness, M., and Shresta, B., "Effects of High Power Lasers", Interim Report No. 6, Informatics Incorporated, Contract MDA93-76-C-0099 (November 12, 1975).

Titanium; laser effect; cratering; surface studies

Armco iron; engineering steel; ShKh-15; laser effect; erosion; surface studies

Engineering steel; iron alloys; aluminum; titanium; copper; laser effect; cratering; surface studies

Iron alloys; cast iron; laser effect; hardening; durability; wear; microstructure

Nickel oxide coatings; copper oxide coatings; cobalt oxide coatings; iron oxide coatings; laser effect; burn-through data; holes; surface studies

Carbides; laser effect; erosion; weight change; surface studies

Aluminum; laser effect; vaporization; surface studies

Molybdenum; laser effect; dislocations; microstructure

314. Johnson, R. L., and O'Keefe, J. D., "Aerodynamic Enhancement Study", Final Report AT-SVD-TR-75-7, TRW Systems Group, Contract N00014-75-C-0082 (June 20, 1975). (AD/B 004 917L)

Aluminum; titanium; stainless steel; laser damage; burn-through data; viscosity; thickness; compressive properties

315. Kibler, K. G., Carter, H. G., and Eisenmann, J. R., "Residual Strength of Laser-Damaged Graphite Composites", Journal of Composite Materials, 9 28-32 (January 1975).

Fiber reinforced composites; resin matrix composites; carbon/resin composite; graphite/epoxy composite; laser damage; penetration depth; residual stresses; mechanical properties; fracture toughness; melting; vaporization

316. Klass, P. J., "Special Report: Laser Weapons. Advanced Weaponry Research Intensifies", Aviation Week & Space Technology, 103, 34-39 (August 18, 1975).

Aluminum oxide; laser damage; vaporization; absorption; thermal properties; thermal coupling; review; no data

317. Kovalev, V. I., Morozov, V. V., Sagitov, S. I., et al., "Strength of Gold Coatings in (Laser) Beams", Kvantovaya Elektronika (Moscow), 2 (7), 1527-1535 (1975).

Gold coatings; copper substrates; nickel substrates; titanium substrates; glass substrates; laser damage; damage threshold; thickness; ultimate tensile strength; mechanical properties; reflectivity; optical properties

318. Kozlova, N. N., Petrukhin, A. I., and Sulyaev, V. A., "Experimental Investigation of the Onset of Evaporation and Formation of a Plasma Layer Due to Interaction Between Laser Radiation and Metals in Different Gases", Soviet Journal of Quantum Electronics, 5 (7), 747-749 (1975).

Aluminum; bismuth; laser effect; evaporation; shock waves; surface studies

319. Lokhov, Yu. N., Mospanov, V. S., and Fiveiskii, Yu. D., "Evaporation and Damage of Entry and Exit Faces of a Transparent Solid Dielectric by a Giant Laser Pulse", Soviet Journal of Quantum Electronics, 5 (5), 488-490 (1975).

Dielectric materials; sapphire; laser damage; melting; cratering; cracking; spalling; absorption; evaporation; damage threshold; thermal stress; surface studies

320. Magee, T. J., "Laser Damage Phenomena in Materials", Interim Report AFOSR TR-75-0389, Stanford Research Institute, Contract AFOSR F 44(620)-73-C-0019 (February 1975). (AD/A 008 879)

Thin films; zinc selenide; potassium chloride; cadmium telluride; aluminum; coatings; laser damage; microstructure; defects; damage threshold; defects; absorption; dislocations; stacking faults

321. Mandl, A., "Aerodynamic Enhancement of Laser Damage to Titanium Alloys", Final Technical Report AFML-TR-75-26, Contract F 33(615)-73-C-5158 (May 1975). (AD/B 011 425L)

Titanium alloys; Ti-8Mn; Ti-6Al-4V; Ti-12Mo-6Zr-5N; laser damage; surface studies; melting; surface removal; weight change; burn-through data

322. Marcus, S., and Lowder, J. E., "Impulsive Loading of Targets by HF Laser Pulses", Journal of Applied Physics, 46 (5), 2293-2294 (May 1975).

Aluminum; laser effect; surface studies; absorption

323. McMordie, J. A., and Roberts, P. D., "Interaction of Pulsed CO_2 Laser Radiation With Aluminum", Journal of Physics D (Applied Physics), 8 (7), 768-781 (May 11, 1975).

Aluminum alloys; laser effect; surface studies; refractive index; modeling; computer program

324. Metz, S. A., Hettche, L. R., Stegman, R. L., and Schriempf, J. R., "Effect of Beam Intensity on Target Response to High-Intensity Pulsed CO_2 Laser Radiation", Journal of Applied Physics, 46 (4), 1634-1642 (April 1975).

Stainless steel; aluminum oxide; magnesium oxide; graphite; fiberglass; Lucite; ceramic materials; aluminum; laser effect; thermal response; thermal coupling; vaporization; absorption; surface studies

325. Moisa, M. I., "Corrosion Resistance of Steel 40Kh After Laser Treatment", Soviet Materials Science, 10 (1), 89-90 (January-February 1975).

Engineering steel; 40Kh; laser effect; surface studies; melting; cracking; weight change; corrosion

326. Moynihan, C. T., Macedo, P. B., Danielson, P. B., and Elterman, P. B., "Laser Hardened Chalcogenide Glass Infrared Windows", Technical Report No. 33, Catholic University of America, Contract N00014-67-A-0377-0028 (September 1975).

Infrared windows; chalcogenide glasses; laser effect; thermal shock; shock hardening; absorption; thermal expansion; failure

327. Murr, L. E., and Szilva, W. A., "Laser-Induced Fracture in Silicon", Journal of Materials Science, 10, 1536-1548 (1975).

Silicon; single crystals; laser effect; fracture; flaws; burn-through data; compressive stress; cleavage; cracking; microstructure; dislocations; stacking faults

328. Payne, D. A., and Ham, I., "Microhardness of Laser Treated Carbide Coatings on Metal Cutting Tools", Wear, 33, 377-379 (1975).

Tungsten carbides; carbide coatings; cutting tools; laser effect; microstructure; microhardness; interfaces; wear

329. Porteus, J. O., Soileau, M. J., Bennett, H. E., et al., "Laser Damage Measurements at Carbon Dioxide and Deuterium Fluoride Wavelengths", Technical Report NWC-TP-5810, Naval Weapons Center (November 1975). (AD/A 017 951)

Mirrors; aluminum alloys; 2024; aluminum coatings; quartz substrates; aluminum substrates; laser damage; damage threshold; surface studies; melting; pitting; cratering

330. Rykalin, N. N., Uglov, A. A., and Kokora, A. N., "Influence of a High-Power CO_2 Laser Beam on Iron and Its Alloys", Translation DRIC-TRANS-4117, DRIC-BR-45195, Defence Research Information Centre (England) (July 1975). (AD/A 014 565)

Iron; iron alloys; Armco iron; engineering steel; ST-45; U-8; KhVG; laser effect; heating; thermal properties; chemical properties; oxidation; mass transfer; degradation

331. Walters, C. T., Beverly, R. E., III, and Negrelli, T. J., "Exploratory Development of Laser-Hardened Materials and Measurement of Laser Beam Parameters and Material Response to High-Power Radiation. Volume I", Technical Report AFML TR-75-183-VOL-1, Battelle-Columbus Laboratories, Contract F 33(615)-73-C-5045 (December 1975). (AD/A 026 831)

Cadmium telluride; sodium chloride; aluminum oxide; titanium alloys; Ti-6Al-4V; laser effect; absorption; reflectivity; distortion; surface studies; burn-through data; thermal response

332. Willis, L. J., and Emmony, D. C., "Laser Damage in Germanium", Optical Laser Technology, 7 (5), 222-228 (1975).

Germanium; single crystals; mirrors; germanium coatings; glass substrates; silicon; laser damage; surface studies; melting; surface defects; cavitation

333. Zakharov, S. I., Lokhov, I. N., Fieveiskii, I. D., and Iampolskii, P. A., "Fission Rupture Mechanism of the Surface of Optically Transparent Dielectrics by a Focused Monopulse Laser", Translation of Zhurnal Prikladnoy Spektroskopii (USSR), 23 (2), 313-316 (1975).

Dielectric materials; laser effect; stress analysis; elastic properties; fracture; surface studies

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334. Arushanov, S. Z., Bebchuk, A. S., and Lomonosov, V. V., "Anisotropy of the Threshold of Optical Strength of Alkali Halide Single Crystals During Damage by Polarized Laser Radiation", Fizika Tverdogo Tela (Leningrad), 18 (5), 1442-1445 (1976).

Alkali halides; potassium bromide; lithium fluoride; single crystals; laser damage; crystal orientation; optical properties

335. Bettis, J. R., "Laser-Induced Damage as a Function of Dielectric Properties at 1.06 Micrometers", Technical Report AFWL-TR-76-61, Final Report, Air Force Weapons Laboratory (July 1976).

Dielectric materials; optical materials; glass; fused silica; fluorides; halides; thin films; coatings; laser damage; damage threshold; surface studies; surface roughness; refractive index

336. Blaszuk, P. R., Hulse, C. O., Waters, J. P., et al., "Exposure Damage Mechanisms for KCl Windows in High Power Laser Systems", Final Report, NASA CR-134982, United Technologies Research Center, Contract NAS 3-18928 (March 15, 1976). (AD/D 108 533)

Laser window materials; potassium chloride; laser damage; optical properties; creep rupture strength

337. Brodin, M. S., Davydova, N. A., and Shablii, I. Yu., "Action of Laser Radiation on the Optical Spectra of Cadmium Sulfide Single Crystals", Fizika i Tekhnika Poluprovodnikov, 10 (4), 625-630 (1976).

Cadmium sulfide; single crystals; laser effect; optical properties; low temperature

338. Chang, C. C., Ho, W. C., and Chan, Y. W., "Effect of Laser Pulse Irradiation on the Critical Temperature of $Ti_{0.8}Nb_{0.2}$ Alloy and Niobium", Cryogenics, 16 (7), 433-435 (July 1976).

Titanium alloys; niobium addition; niobium; thin films; foils; laser effect; heating; annealing; superconductivity; phase transformation; transition temperature

339. Clauer, A. H., Fairand, B. P., and Wilcox, B. A., "Pulsed Laser-Induced Deformation in an Fe-3Si Alloy", Manuscript submitted for publication in Metallurgical Transactions (April 20, 1976).

Iron alloys; Fe-3Si; laser effect; plastic deformation; shock hardening; stress waves; microstructure; twinning; slip

340. Danileiko, Yu. K., Manenkov, A. A., and Nechitailo, V. S., "Subthreshold Effects During the Laser Damaging of Optical Materials", Kvantovaya Elektronika, 3 (2), 438-441 (1976).

Optical materials; sapphire; glass; laser damage; surface damage; bulk damage

341. Fairand, B. P., and Clauer, A. H., "Effect of Water and Paint Coatings on the Magnitude of Laser-Generated Shocks", Manuscript submitted for publication in Optics Communcations (April 19, 1976).

Aluminum; zinc; foils; water coatings; paint coatings; laser effect; absorption; surface studies

342. Geptin, A. P., Larina, R. R., and Mirkin, L. I., "Features of the Dislocation Structure of Zinc Emerging During Laser Beam Action", Izvestia VUZ Fiziki, 19 (4), 26-30 (1976).

Zinc; laser effect; microstructure; dislocations; plastic deformation; slip

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Graphite; laser effect; cratering; cavitation; surface studies; absorption; phase diagram; microstructure

344. Gorshkov, B. G., Denileiko, Yu. K., Epifanov, A. S., et al., "On the Mechanism of Laser-Induced Fracture of Alkali Halide Crystals: Study of the Temperature Dependence of Fracture Thresholds", Pis'ma Zhurnal Tekhnicheskoy Fiziki, 2 (6), 284-287 (1976).

Alkali halides; sodium chloride; potassium bromide; potassium chloride; sodium fluoride; lithium fluoride; laser damage; damage threshold; fracture; temperature effect; surface studies

345. Gridin, V. A., Krotov, V. A., and Petrovskii, A. N., "Damage of KDP (Potassium Dihydrogen Phosphate) Crystals by Ultrashort Laser Pulses", Kvantovaya Elektronika, 3 (2), 311-315 (1976).

Potassium dihydrogen phosphate; laser damage; damage threshold; surface studies

346. Harrigan, W. C., Jr., "Analysis of Elevated-Temperature Impact Fractures of Graphite-Reinforced Aluminum Composites", Technical Report, Aerospace Corporation (no date given–received March 15, 1976).

Fiber reinforced composites; graphite/Al composite; metal matrix composites; aluminum alloys; casting alloys; rapid heating; short time; elevated temperature; impact test; fracture surface; flexure strength; microstructure

347. Harth, G. H., Leslie, W. C., Gregson, V. G., et al., "Laser Heat Treating of Steel", Journal of Metals, 28 (4), 5-11 (April 1976).

Engineering steel; AISI 1045; Armco iron; manganese phosphate coatings; laser effect; surface studies; cracking; reflectivity; absorption; mictostructure; phase transformation

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Aluminum; titanium alloys; Ti-6Al-4V; laser effect; damage threshold; absorption; thermal coupling

349. Kruer, M., Esterowitz, L., Allen, R., et al., "Thermal Models for Laser Damage in Indium Antimonide Photovoltaic and Photoconductive Detectors", Infrared Physics, 16 (3), 375-384 (1976).

Indium antimonide; laser damage; damage threshold; thermal properties

350. Leung, K. M., Tang, C. C., and DeShazer, L. G., "Laser Damage of Cadmium Sulfide and Zinc Sulfide Thin Films", Thin Solid Films, 34 (1), 119-123 (1976).

Cadmium sulfide; zinc sulfide; thin films; coatings; laser damage; damage threshold; absorption; optical properties; surface studies

351. Magee, T. J., "Studies of Laser Damage Phenomena in Materials", Interim Report AFOSR TR-76-0157, Stanford Research Institute, Contract F 44(620)-73-C-0019 (January 15, 1976). (AD/A 023 269)

Potassium chloride; zinc selenide; aluminum; alkali halides; laser damage; surface studies; absorption; microstructure; dislocations; stacking faults; precipitation

352. Marcus, S., Lowder, J. E., Manlief, S. K., et al., "Laser Heating of Metallic Surfaces", Technical Report ESD-TR-76-122, Massachusetts Institute of Technology, Contract F 19(628)-76-C-0002 (May 20, 1976). (AD/A 028 580)

Aluminum; copper; titanium; laser effect; surface studies; thermal coupling; absorption; damage threshold

353. Matsuoka, Y., "Laser-Induced Damage to Semiconductors", Journal of Physics D, 9 (2), 215-224 (1976).

Semiconductors; silicon; laser damage; damage threshold; surface studies; cracking; thermal stress

354. Mirkin, L. I., "Physical Principles of the Treatment of Materials by Laser Beams (Chapters 2 and 8)", Machine translation FTD-ID (RS)T-2401-75 of Fizicheskiye Osnovy Obrabotki Materialov Luchami Lazers. Izd-vo Moskovskogo Universiteta (USSR), 25-62, 267-320, 1975 (January 1976). (AD/B 009 059L)

Copper alloys; tungsten carbide; aluminum; bismuth; iron; graphite; polymethylmethacrylate; surface studies; melting; cratering; microstructure; dislocations; fracture

355. Nebolsine, P. E., "Laser Simulation of Hypervelocity Impact -- on Nose-Tip Materials", American Institute of Aeronautics and Astronautics, 14th Aerospace Sciences Meeting, Washington, D.C., AIAA Paper 76-52 (January 26-28, 1976).

Graphite; brittle materials; laser effect; heating; impact properties; cratering; erosion resistance; particle size distribution

356. Smith, W. L., Bechtel, J. H., and Bloembergen, N., "Dielectric Breakdown Induced by Picosecond Laser Pulses", Technical Report TR-665, Harvard University, Contracts N00014-75-C-0648 and F 44(620)-75-C-0088 (October 1976). (AD/A 031 852)

Alkali halides; quartz; sapphire; calcium fluoride; glass; aluminum oxide; potassium chloride; lithium fluoride; laser effect; damage threshold; refractive index; surface studies; bulk damage; dielectric properties

357. Tews, P., Pence, P., Sanders, J., et al., "Electron Beam Welding Spike Suppression Using Feedback Control", Welding Journal, 55 (2), 52s-55s (February 1976).

Aluminum alloys; 7075-T6; electron beam welding; weld defects; short time; depth of penetration; microstructure

358. Tovstyuk, K. D., Plyatsko, G. V., Nikonyuk, E. S., et al., "Features of the Interaction of Intensive Laser Radiation With Cadmium Telluride Single Crystals Doped With Bromine and Germanium", Ukrainskiy Fizicheskiy Zhurnal, 21 (4), 689-691 (1976).

Cadmium telluride; single crystals; bromine addition; germanium addition; laser effect; surface studies; recrystallization

359. Whittaker, A. G., Kintner, P. L., Nelson, L. S., et al., "A System Employing Laser Heating for the Measurement of High-Temperature Properties of Materials Over a Wide Pressure Range", Technical Report SAMSO TR-76-133, Aerospace Corporation, Contract F 04(701)-75-C-0076 (July 7, 1976). (AD/A 029 459)

Refractory materials; laser heating; physical properties; surface studies; phase studies

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